

the Universities and other Educational Institutions by Prof. Bonney, and reply by Prof. Credner; the Academies and Learned Societies by Prof. Miers, and reply by Prof. Barrois; the Geological Surveys by Prof. Lapworth, and reply by Prof. Heim; Engineering and Mining Institutions by Prof. Hughes, and reply by Prof. Beck; the Delegates and other Guests by Dr. Marr, and reply by Prof. Stevenson; and the Ladies by Prof. Watts, and reply by Prof. Walther.

On Friday, September 27, visits were paid to the British Museum at Bloomsbury and to the Natural History Museum at South Kensington, to the Geological Survey and Museum of Practical Geology at Jermyn Street, and to the Victoria and Albert Museum at South Kensington. Demonstrations on objects of interest were given by the officers at these institutions, and especial interest was manifested in the new model of Assynt in the north-west Highlands (recently added to the Museum of Practical Geology), which was explained by Dr. B. N. Peach. A number of the foreign and colonial visitors were also invited to St. Paul's Cathedral, and were conducted through the edifice by Canon Scott Holland and Dr. Grabham (delegate appointed by the Royal College of Physicians). The party was afterwards entertained at tea by Dr. Grabham in the Chapter House.

In the evening the foreign and colonial delegates were entertained at dinner at the Criterion Restaurant by the Geological Society Club. This club was founded in 1824 by Buckland, Fitton, Greenough, Lyell, Warburton, and others, with the object of affording to a limited number of the leading members of the society an opportunity of dining together on the evenings of the society's meetings. The proceedings on the present occasion lacked some of the exuberance and animation that we read of in early records of the club, when Buckland and Sedgwick and other geological giants of old made merry. On the present occasion, however, the proceedings had to be curtailed.

The party, as in the case of the official dinner, was photographed, and a congratulatory telegram was sent to the distinguished veteran and past president, Dr. H. Clifton Sorby, now in his eighty-second year, and still engaged in scientific research. It may be mentioned that other veteran fellows of the society, Prof. T. Rupert Jones, now eighty-eight, and the Rev. Osmond Fisher, in his ninetieth year, bear testimony to the healthy character of geological labour. Nor should we forget the father of the society, the Rev. W. H. Egerton, a brother of the late Sir Philip Egerton, who was elected a fellow in 1832, and at the age of ninety-six is still rector of Whitchurch, in Shropshire. A letter received from him during the present year, in which he mentioned that he had been a pupil of Buckland, was exhibited in the society's museum.

After the club dinner the party proceeded to the conversazione, which was held at the Natural History Museum. There a numerous company was received by the president in the Central Hall, and the proceedings were enlivened by a good programme of music, performed by the string band of the Royal Engineers.

During the week prior to the centenary reception a number of excursions were made with the view of exhibiting to the foreign members, correspondents and others who came from abroad, the main features of British geology. The longer excursions were arranged to occupy a week.

The Palæozoic formations were seen in the English Lake District, famed for the early researches of Sedgwick; in South Wales, where Murchison established some of his Silurian divisions; and at Bristol, Weston-super-Mare, and Cheddar, amid geologic scenes described by Buckland and Conybeare. The

Jurassic and Cretaceous rocks were viewed along the Dorset coast at Lyme Regis, Bridport, and Weymouth, a region full of associations with the work of De la Beche and Buckland; and in the Isle of Purbeck at Lulworth and Swanage, where Thomas Webster in early days so admirably depicted the geological structure. The excursion to the Isle of Wight was abandoned, while that proposed for the Edinburgh district was replaced by one to the north west Highlands, to Assynt, Inchnadamph, and Loch Glen Coul for the purpose of studying the displaced rock-masses brought forward by the Glen Coul and Moine thrusts. This last excursion was the more appropriate considering that the long-looked-for Geological Survey memoir on the North-west Highlands, embodying the researches of Dr. Horne, Dr. Peach, Dr. Teall, Mr. Clough, and other colleagues, has just been published under the editorship of Sir Archibald Geikie.

Some shorter excursions for two days were made to May Hill, Westbury-on-Severn and the Forest of Dean, to Derbyshire, and to the Crag District of Suffolk.

On Saturday, September 28, there was a series of day excursions, all well attended, to the Northampton iron-ore district, to Aylesbury, to Dover, to Box Hill, Leatherhead and Dorking, to Reading, to Erith and Crayford, and to Sudbury. Thus opportunity was given of seeing many important and interesting geological sections.

On Monday, September 30, and following days, the foreign and colonial visitors were entertained at the Universities of Oxford and Cambridge. At Oxford the degree of D.Sc. *honoris causa* was conferred upon Prof. Charles Barrois, of Lille, Prof. Albert Heim, of Zurich, Prof. Alfred Lacroix, of Paris, Dr. Albrecht Penck, of Berlin, Dr. Hans Reusch, of Christiania, and Prof. (Geheimrath) Ferdinand Zirkel, of Leipzig. At Cambridge the degree of Sc.D. *honoris causa* was conferred upon Prof. Waldemar Christofer Brögger, of Christiania, Prof. (Geheimrath) Hermann Credner, of Leipzig, Prof. Louis Dollo, of Brussels, Prof. Albert de Laparent, of Paris, and Prof. Alfred Gabriel Nathorst, of Stockholm. Prof. (Geheimrath) Heinrich Rosenbusch was unfortunately prevented from attending.

All the recipients of the degrees are foreign members of the Geological Society. Thus was honour done to the society and to many of its distinguished representatives abroad.

H. B. W.

THE FOURTEENTH INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY.

THE fourteenth International Congress of Hygiene and Demography, which meets every four years, was held this year in Berlin from September 23 to September 29, under the presidency of Prince Heinrich zu Schönau-Cherath, the vice-presidents being Profs. Rönner and von Mayr. It was organised in nine sections, comprising every branch of hygiene and demography, bacteriology, parasitology and preventive medicine; general, industrial and school hygiene; port-sanitary and military and naval hygiene; dietetics, life-saving and statistics. Some 4000 members of all nationalities attended the sittings, and were received everywhere with the utmost courtesy and kindness. The meetings were held in the Reichstag buildings, which are central and admirably adapted for the purpose. The question naturally suggests itself, would the British Government pursue the enlightened policy of placing the Houses of Parliament or similar buildings at the disposal of such a congress meeting in England?

The weather throughout was delightful, and many social functions, including excursions, receptions

by Prince Heinrich and the British Ambassador, a banquet, a gala performance at the Opera, concerts, &c., served to make the time pass pleasantly. In addition, visits were organised to all the principal scientific institutions, and were much appreciated. These included the laboratories of the Imperial Board of Health and of the University, the hospitals, sanatoria, schools, &c. It is impossible to do more than glance at a few of the more important communications; the full papers will be published hereafter in a volume of Transactions.

There was an important debate on tuberculosis, and some difference of opinion existed as to the most usual mode of infection in man. Prof. Arloing, of Lyons, discussed the question of the existence of different types of the tubercle bacillus. He said that he had become convinced that the bacillus of this disease is but one, and that the species or types described by several observers are but temporary races or varieties, the apparent fixity of which does not survive the conditions of their surroundings. He considered that:—

- (1) The types are rarely defined in a perfect manner;
- (2) they are blended together in an almost indefinite series of individuals which in growth, shape, and virulence admit of a gradual passage from one to the other;
- (3) variability is sufficient to explain the usual characteristics of tuberculosis in *Mammalia* and in birds;
- (4) there would be real danger, from the medical as well as the hygienic point of view, in making such unstable differences a basis for laying down principles for the prophylaxis of tuberculosis.

Dr. Ravenel, of Philadelphia, considered that:—

- (1) The alimentary tract is a frequent portal of entry for the tubercle bacillus.
- (2) The tubercle bacillus is able to pass through the intact mucous membrane of the alimentary tract without producing a lesion. This takes place principally during the digestion of fats.
- (3) The bacilli pass with the chyle through the lacteals and thoracic duct into the blood, which conveys them to the lung, where they are retained largely by the filtering action of the tissues.
- (4) Infection through the alimentary tract is especially frequent in children.
- (5) Milk from tuberculous cows is the source of infection in many cases. Our present knowledge does not enable us to state the exact proportion of cases of tuberculosis due to this cause, but it is probably considerable.

Prof. Flugge, of Breslau, said that he had performed experiments which showed that tuberculosis could be communicated to animals by inhalation, and that the dose of bacilli required to infect by the respiratory tract was very far less ("millions of times") than that required to infect by the alimentary tract. The mode of infection in man doubtless varied, and children may be infected by the digestive tract by tuberculous food, particularly milk, but the most extensive source of infection is the number of droplets of tuberculous expectoration coughed up by consumptives; these float in the air and serve as sources of infection to others. Prof. Ribbert, of Bonn, and Prof. v. Schrötter, of Vienna, also from the evidence of autopsies considered inhalation as the chief mode of infection in man. Prof. Calmette, of Lille, believed that in the young, infection by the digestive tract, particularly by tuberculous milk, is the most frequent, and attached little or no importance to dry dust containing tubercle bacilli as a source of infection.

Another important discussion was on typhoid and paratyphoid infections of man and the campaign against typhoid fever. Prof. Löffler, of Greifswald, discussed the classification of the causative micro-organisms of these diseases, and their isolation and differentiation by means of sugar nutrient media containing a small percentage of the anilin dye

malachite green. Dr. Lentz, of Berlin, pointed out that the bacteria of typhoid and paratyphoid fevers pass by the lymphatics from the digestive tract to the spleen, bone-marrow and blood, and are excreted by the kidneys, in some cases for long periods. Of great importance also are mild cases, sometimes amounting merely to slight indisposition; though the individual may be but little, if at all, ill, he at the same time excretes the bacillus, and thus may be a source of infection to others. Some of the paratyphoid fevers of man seem to be caused by organisms which produce diseases in the lower animals. Anti-typhoid inoculation was discussed by Prof. Wright, Col. Leishman, R.A.M.C., and Dr. Muschold. The latter, from Prussian statistics, considered the method very promising.

Plague naturally attracted some attention, and Dr. Giemsa, of Hamburg, discussed the best methods of ridding ships of rats. He preferred to expose the hold to a mixed gas, produced in a generator, consisting of 5 per cent. carbon monoxide, 18 per cent. carbon dioxide, and 77 per cent. nitrogen. Dr. Strong, of Manila, discussed the subject of preventive inoculation in plague. He considered that this was the mode of combating the disease which held out the most likelihood of success, and made out a strong case for the use of living but attenuated cultures of the plague bacillus as the prophylactic material. Prof. Gaflyk, of Berlin, considered the spread of plague to be due primarily to rats, vermin transmitting the bacillus from rat to man.

In a paper on insects as carriers of disease, Dr. Dönitz pointed out that the ticks are intermediate hosts of spirochætae and piroplasmata; the parasites pass through a developmental stage, and it is not until this has occurred that they can again infect man and animals. He referred to the present lack of knowledge concerning the structure and developmental history of the ticks, and to the confused nomenclature of these insects now existing.

Many papers were devoted to a consideration of parasitic protozoa. Dr. Doflein discussed the nature of spirochætes, as to whether they are bacteria or protozoa, and their mode of division. Prof. v. Wasielowski, of Heidelberg, believed that all parasitic protozoa can act occasionally as pathogenic agents. The Leishman-Donovan body of the Indian disease kala-azar seemed to be a flagellated protozoon; the piroplasmata also seemed to be allied to the flagellates. Prof. Hewlett, of London, considered the parasites of the different malarial fevers to be distinct species, and the piroplasmata, or some of them, to be more nearly allied to the hæmoflagellates than to the hæmosporidia.

The campaigns against malaria and yellow fever were fully discussed. Prof. Ross, of Liverpool, gave a history of the institution of anti-malaria measures and of their results in Sierra Leone, Lagos, Federated Malay States, Panama, and Ismailia; Prof. Savas, of Athens, described the malaria campaign in Greece; and Prof. Celli, of Rome, that in Italy. The latter advocated drainage, mechanical means to render the mosquitoes innocuous, e.g. by the use of netting, &c., and the regular prophylactic use of quinine. Prof. Agramonte, of Havana, described the epidemiology of yellow fever and the campaign against the disease in Havana. He considered that the results obtained in the control and extinction of recent epidemics of this disease confirm the truth of the doctrine of mosquito transmission in its propagation.

Under the heading of dietetics, the subject of the necessary minimum of proteins for alimentation naturally came up for discussion. Prof. Forster, of Strassburg, gave the following as his conclusions:—

(1) Besides albumen, fat, and carbohydrates, man requires for his nourishment certain substances which are contained in animal and vegetable food in varying quantities. These substances are both in quantity and quality related to the nitrogenous ingredients of food.

(2) Digestive and other ferments, the internal secretions, protective matters, &c., are nitrogenous substances or descendants of such; their production must therefore be dependent to a certain extent on the intake of albumen and the conversion of the same in the body.

(3) Until the relations both of quantity and of quality are better understood, it will be advisable for general biological and hygienic reasons to favour an ample proportion of protein in practical nutrition, and not to limit the amount of protein to the minimum with which nitrogenous equilibrium can apparently be maintained.

The alcohol question also was to the fore, but a somewhat guarded opinion seemed to be expressed regarding its supposed evil effects when used in moderation. Dr. Triboulet, of Paris, considered that alcoholic drinks had an unfavourable action in cases of tuberculosis, and that alcohol diminishes resistance and predisposes to tuberculosis. Dr. Moeli, of Berlin, considered that alcohol is not a food, is not necessary, and in many cases is detrimental, and that its use should be discouraged in every way, not only by teaching the masses the evil effects of its use, but by instituting other interests so that the lack of it should not be felt.

Industrial diseases, particularly lead and mercurial poisoning, and those arising from dust, strain, &c., were the subject of several papers, and many suggestions were made to mitigate these evils. Lighting, ventilation and water supplies were also dealt with, and likewise statistics. According to Prof. Ballod, the recent Prussian mortality tables show that as regards mortality the country has a decided superiority over the towns, but that this superiority is only distinctly noticeable among the male sex, and at ages 40-50 years the towns appear to be slightly more favourable than the country.

At the general meeting telegrams of congratulation were received from the German Emperor and Empress, Lord Lister, and others, and three special lectures by English, French, and German men of science respectively were delivered. Dr. Haldane discussed his researches on the effects of high pressures and temperatures in underground workings on man. No ill effects result with pressures below about three atmospheres, but above these, unless the pressure is increased or decreased step by step, as the case may be, grave effects may be produced. As regards temperature, it is the wet-bulb temperature which determines the suitability of atmospheric conditions in mines. The optimum wet-bulb temperature is below 27° C., the maximum that can be sustained without danger being 31° C. Prof. Chantemesse (Paris) discussed the serum treatment of typhoid fever. By growing the typhoid bacillus in a spleen broth medium for a week, heating to 55° C., and injecting into horses, the serum of the latter acquires properties which usually act favourably on the course of the disease when injected into the patient. Thus, in the Paris hospitals from 1901-7, among 5621 cases the mortality was 17 per cent., but during the same period in 1000 cases treated by Prof. Chantemesse with his serum the mortality was only 4.3 per cent. Prof. Schattenfroh, of Vienna, lectured on the hygienic care of water supplies, and the chemical and bacteriological examinations of drinking water. He urged that an international commission should be formed to devise standard methods for carrying out the latter.

The museum arranged in connection with the congress was of the greatest interest. The exhibits of the Imperial Board of Health and of the Institute for

Infectious Diseases were especially noteworthy. They consisted of cultivations of pathogenic micro-organisms and drawings and photographs of the same, pathological specimens of tuberculosis and other diseases, series of specimens demonstrating agglutination and precipitin tests for blood, travelling laboratories, &c. All the principal Continental firms showed chemical and bacteriological apparatus, microscopes, and other instruments, and many of the casts showing pathological conditions were marvels of modelling. The exhibit of the Bacteriological Institute of Rio de Janeiro also was a large and comprehensive one, showing what good work is being done abroad, and it is to be regretted that exhibits from the British Empire seemed to be almost entirely wanting.

Demonstrations on the use of apparatus were given, and one interesting exhibit under the microscope was that of living active spirochaetes, minute micro-organisms which occur in relapsing fever, syphilis, and certain animal diseases.

THE HARD AND SOFT STATES IN DUCTILE METALS.

WHEN the early craftsmen first observed that the metals they worked in were made harder by hammering, and that the original softness could be again restored to the hardened metal by heat, it probably did not occur to them that any explanation of these useful properties was called for. At a later period, when an interest in the reasons for things became more general, it is probable that hardening was attributed to the compacting of the substance by the driving of its particles closer together so that the mass as a whole became less open or porous. In the same way heat annealing was probably assumed to act by permanently expanding the metal and opening up its texture. So many analogies to these operations were ready to hand from the most common and everyday experiences that it is not surprising that even on closer inquiry this explanation should continue for a time to be accepted as sufficient, the more so as it was obviously true that in some cases unworked metal had an openness or porosity which could be removed by hammering or working. While the researches of chemists on the density of the metals showed plainly that increase of density does not always result from compacting by pressure, these researches were probably too far removed from the ken of those who were most intimately concerned with the working of metals to arouse them to the insufficiency of the existing explanation of hardening.

In the latter part of the past century the views of physicists and chemists on the influence of molecular structure on the properties of matter began to find application in the field of scientific metallurgy. In particular, much attention was directed to the study of the crystalline constituents of alloys and to the influence of heat treatment on their equilibrium. The study of the iron alloys also led to the development of the view that iron itself can exist in several allotropic forms; thus the idea of allotropy was introduced into practical metallurgy.

Mr. G. T. Beilby's researches,¹ which form the subject of the present article, indicate that all crystalline substances can also exist in a non-crystalline or amorphous form, and that the properties of these two forms are so distinct that they must be regarded as definite allotropic modifications. Observations on the stability of these forms, and on the conditions under which the one form can pass into the other, confirm this view. As these general principles have been found to apply

¹ "The Hard and Soft States in Ductile Metals." By G. T. Beilby F.R.S. Paper read before the Royal Society on June 27.